

Report for 2004AR73B: Nutrient losses in runoff and leaching from poultry litter applications to loblolly pine stands and pastures

There are no reported publications resulting from this project.

Report Follows

Problem and Research Objective:

The poultry industry in the United States and Arkansas produces large amounts of poultry litter that needs to be disposed of in an environmentally sound manner. This litter is commonly applied to pastures to increase forage production. Repeated application of poultry litter in pastures has led to reductions in water quality and increases in the amount of nutrients that are drained from watersheds that contain high densities of poultry production. Current policies and regulation may limit the amounts of poultry litter that can be applied to pastures in these watersheds and suitable, alternative applications sites are needed to maintain a viable poultry industry in many locations in Arkansas. Loblolly pine forests could be suitable application sites for poultry litter since pine tree growth responds well to nutrient additions and forest soils have attributes that limit surface runoff or mitigates off site transport of contaminants. The objective of this study is to evaluate the ability of loblolly pine plantations to environmentally mitigate nutrient and metal additions from poultry litter application. Specific objectives include to: 1) quantify and compare the impacts of poultry litter application to forests and pastures on nutrient and other environmentally important elements in surface water runoff 2) quantify and compare the impacts of poultry litter application to forests and pastures on nutrients and other environmentally important elements in soil water.

Methodology:

A field study was implemented on pastures and a loblolly pine plantation growing on similar soils in Southwestern Arkansas. The trees were 26 years old at the time of study establishment and the pastures, which are used for hay production, contain a mixture of Bermuda grass, Bahia grass, tall fescue and clovers. Treatment application and water monitoring occurs on six 0.4-ha plots within the pine plantation and another six plots in the pastures. Three of the plots in the pine plantation and three of the plots in the pastures received a nine Mg/ha application of poultry litter in April of 2004. Surface water was collected in a 102 m² runoff plot and soil water was collected using four tension lysimeters within each 0.4 ha plot in the pastures and loblolly pine plantation. Total flux of surface water was determined for each runoff plot. Nutrient concentrations (N, P, K, Ca, Mg, Total As, As(V), As(III) and other selected micronutrients) were determined for all or a subset of water samples collected by the runoff plots and lysimeters.

Principal Findings and Significance:

Preliminary results indicate substantial increases in nitrogen and phosphorus in surface and soil water from both the pastures and the loblolly pine plantation following litter application. For example concentrations of P in soil water during the initial four months following litter application were 0.11 mg/l in plots receiving poultry litter but only 0.03 in control plots. Differences in the response of P to litter application between the pastures and plantations were not significant. PO₄-P concentrations in runoff, collected from three storm events that occurred 7-10 months after litter application, were 15 times higher in litter amended plantation plots but only 0.5 times in litter amended pasture plots than in the associated unamended plots for each landuse type. Fluxes of PO₄-P from litter applied to each landuse

are more similar since greater amounts of runoff occurred in the pastures than loblolly pine plantation.

Poultry litter application increased $\text{NO}_3\text{-N}$ and $\text{NH}_4\text{-N}$ concentrations of soil water in both the pine stands and pastures. The magnitude of increases was greater in the pine plantations than the pastures. For example $\text{NO}_3\text{-N}$ concentrations in soil water collected in the pine stands and pastures were respectively 0.03 and 1.7 mg/l in the unamended plots but 2.1 and 5.2 mg/l in the poultry litter amended plots. Overall $\text{NO}_3\text{-N}$ concentrations were consistently greater in the pastures than the pine stands regardless of the litter treatment. The higher concentrations of N in the pastures were most likely related to the accumulation of N as result of long-term, repeated application of fertilizer in this pastures. Differences in $\text{NO}_3\text{-N}$ concentrations in surface water between amended and unamended plots were similar to differences found for $\text{PO}_4\text{-P}$, discussed above.